Ex. 6 Personal Privacy (PP) Testimony May 8, 2017

I don't believe that ISL uranium mining is a beneficial use of our groundwater or that disposal of wastewater via land application or in Class V disposal wells is in the public interest. I am not a hydrogeologist or geochemist. However I can and do read scientific research and three areas of the proposed project concern me:

-The fate of contaminated mine waste materials.

-Aquifer restoration following ISL uranium mining.

-Our choice of uranium as an energy source.

My first concern is the fate of the toxic waste produced by ISL uranium mining.

According to the Powertech Ground Water Discharge Permit Application, (section 3.7.1.2), the proposed perimeter of operational pollution lies at the base of the Beaver Creek Basin and the Pass Creek sub-basin, watersheds that drain approx. 1,400 square miles. Three miles downstream, these basins empty into the Cheyenne River. I believe that what happens in one part of a watershed can affect everyone who lives within the basin.

In the description of "land application water properties" (section 5.8) wastewater will be treated with ion exchange for uranium removal followed by radium removal through co-precipitation with barium sulfate in radium settling ponds. There is mention of leak detection systems in these ponds, but no plan for repairing these leaks. Radium is a dangerous waste material and little information is provided about how it will be handled.

The proposed well fields are located approx. 2 miles southeast of a large fault. I've witnessed the consequences of an excursion of contaminated groundwater along a fault near Nemo, SD, where I live. This excursion event was only discovered some 20 years after the contaminant was disposed of. Costs for water transport and water treatment were considered to be too high and the community has relied on a single, remote well for the past 15 years.
(Contaminant Survey and Site Characterization Report; Executive Report, USDA Forest Service Nemo Work Center, Nemo,SD September 3, 1997.)

I believe that Powertech is overconfident in stating that they will simply "pump back" any excursions of lixiviant that occur.

The contaminated mine wastewater disposal method has not been finalized. Powertech's preferred disposal method is injection of treated wastewater into 4 to 8 Class V deep disposal wells drilled into the Minnelusa and/or Deadwood formations. They have stated they will perform the necessary feasibility tests for this method only AFTER the EPA has issued the permit for the Class V deep disposal wells.
(Powertech report on the Inyan Kara and Madison Water Rights Permit applications.)

I am concerned that even if a monitoring plan seems adequate, there is significant potential for surface leaks, accidental spills, well casing failures and excursions of production and wastewater. Government responsibility for permitting and oversight is fragmented. The high cost of reclamation has often fallen on the taxpayer in the long run. This project cannot be in the public interest.

(According to the 2002 USGS Atlas of Water Resources in the Black Hills Area: "Human influences have the potential to degrade water quality for both ground water and surface water. For ground water, the potential for contamination can be large. For surface water, various land-use practices can affect water quality. Two Superfund sites have been listed in the BH area primarily related to concentrations of various trace elements resulting from mining activities".)

My second concern has to do with the aquifer restoration plan.

According to the Powertech report on both the Inyan Kara and Madison Water Rights Permit applications:

Powertech proposes to restore the contaminated aquifers by treating water pumped from production wells using reverse osmosis membranes under high pressure, thus removing 90% of dissolved constituents. Restored water will then be returned to injection wells and the RO reject (brine) will be disposed of in Class V wells.

Powertech has concluded that minimal benefit, if any, is derived from the groundwater sweep prior to deep well injection and suggests eliminating groundwater sweep as an unnecessary, ineffective and consumptive step in the restoration process.
(Section 6.2.2.2 of the Powertech Large Scale Mine permit application)

According to the EPA "High pressure reverse osmosis can only be *employed after groundwater sweeping*, because the high concentration of contaminants during the initial stages of the restoration process tend to disrupt the RO membranes".
(Appendix III. Occupational and Public Health Risks Associated with In-Situ Leaching, in: Technical Report on Technologically Enhanced Naturally Occurring Radioactive Materials from Uranium Mining Volume 2; EPA 402-R-08-005; 2008)

My third concern is the assumption that ISL uranium mining will contribute to clean energy and a reduction in greenhouse gas emissions.

According to the Powertech website, Powertech Uranium is "well-positioned for rapid growth in the burgeoning US nuclear power industry".

In 2002 the Bush/Cheney administration's "Nuclear Power 2010 Program" provided large subsidies for a handful of Generation III+ demonstration plants. The expectation that these plants would be built and come online by 2010 has not been met.

There has been no ground-breaking on new nuclear plants in the United States since 1974. Until 2013, there had been no ground-breaking on new nuclear reactors at existing power plants since 1977. As of 2012, nuclear industry officials say they expect five new reactors to enter service by 2020; these are all at existing plants. As of August 2013, there are construction delays at two new reactor projects. In 2013, four aging reactors were permanently closed before their licenses expired because of high maintenance and repair costs at a time when natural gas prices have fallen. The state of Vermont is trying to close Vermont Yankee. New York State is seeking to close Indian Point, 30 miles from New York City. As of the present date, there appears to be a net loss of nuclear reactor numbers in the US, rather than a so-called "burgeoning industry".
(New York Times, June, 2013)

Powertech has also stated that the company would like to sell uranium oxide on the world market, especially to the BRIC nations; Brazil, Russia, India and China. Nearly all of the reactors that have been built or are under construction in these countries are light water reactors. (International Atomic Energy Agency website, October, 2013)

The hope that breeder reactors would replace light water reactors and that more economic means of reprocessing spent fuel would be developed has not been realized. At present, it is generally found to be cheaper to mine new uranium, which is then used in a "once-through" process that creates spent fuel, the radioactive waste that is considered to be the "Achilles heel" of nuclear energy.

The nuclear industry seeks the cheapest ore, for use in the least efficient way, by an energy industry energy that is fraught with dangerous waste and high costs associated with construction, operation, repair, decommissioning and clean-up after accidents.

Various agencies have tried to estimate how long all of these primary sources of uranium will last, assuming a once-through cycle. The European Commission said in 2001 that at the current level of uranium consumption, known uranium resources would last 42 years.
(The Times: London "Uranium Shortage Poses Threat" August, 2005).

Thus, in order to provide nuclear power for a period ending during the lifetimes of many living today, we leave permanent, potential increased contamination of *soils, river systems and aquifers.*

The problems of global warming that the nuclear industry hopes to alleviate have also driven the development of renewable energy. The Intergovernmental Panel on Climate Change has said that there are few fundamental technological limits to integrating a portfolio of renewable energy technologies to meet most of total global energy demand.

In a 2009 Scientific American article entitled "A Path to Sustainable Energy", researchers write that producing all new energy with wind power, solar power, and hydropower by 2030 is feasible and that existing energy supply arrangements could be replaced by 2050. Barriers to implementing the renewable energy plan are seen to be "primarily social and political, not technological or economic". The authors say that energy costs with a wind, solar, water system should be similar to today's energy costs. The authors only consider technologies that have near-zero emissions of greenhouse gases and other pollutants over their entire life cycle, including construction, operation and decommissioning. Similarly, they only consider technologies that do not present significant waste disposal or terrorism threats.

An intriguing result of their plan would be a decline in global power demand. That would occur because, in most cases, electrification is a more efficient way to use energy. For example, only 17 to 20 percent of the energy in gasoline is used to move a vehicle (the rest is wasted as heat), whereas 75 to 86 percent of the electricity delivered to an electric vehicle goes into motion. They note that the world manufactures approx. 73 million cars and light trucks every year. (Scientific American; November, 2009; Mark Jacobson and Mark Delucchi)

The International Energy Agency has stated that the deployment of renewable technologies usually increases the diversity of electricity sources and, through local generation, contributes to the flexibility of the system and its resistance to central shocks. Bringing these possibilities into present perspective, my husband and I have lived affordably and comfortably in a house exclusively powered by solar electricity for the past 5 years.

If we run out of oil, coal, natural gas or uranium, we can make use of many other energy sources. There are no alternatives to water.

For these reasons, I do not believe that employing large quantities of water to mine uranium is a beneficial use of water. The risk of degrading large quantities of water, for the private gain of a few, is not in the public interest.

Respectfully submitted,

Ex. 6 Personal Privacy (PP)

CONTAMINANT SURVEY AND SITE CHARACTERIZATION REPORT

EXECUTIVE REPORT

USDA FOREST SERVICE
NEMO WORK CENTER

Nemo, South Dakota

September 3, 1997

Submitted to:

Bill Schleining
On–Site Coordinator
U. S. Department of Agriculture, Nemo Forest Service
RR 2 Box 200
Highway 385 North
Custer, South Dakota 57730–9501

Prepared by:

EnviroSearch International
2319 South Foothill Drive, Suite 180
Salt Lake City, Utah 84109
Ph. (801) 461–0888
Fx. (801) 461–0008

INTRODUCTION

EnviroSearch International was contracted by the U. S. Department of Agriculture / Forest Service (USDA–FS), Rocky Mountain Region, to conduct a contaminant survey and hydrogeologic characterization at the USDA–FS Nemo, South Dakota Work Center. This work was initiated after pesticides were detected in the local domestic water supply aquifer. All work was performed from January 1997 through June 1997.

A three volume Contaminant Survey and Site Characterization Report was submitted to the USDA–FS on September 3, 1997. The purpose of the three volume report was to: (1) summarize previous work relevant to the pesticide investigation; (2) acquire data needed to delineate contaminated groundwater, identify contaminant migration pathways and evaluate potential sources or source areas of pesticide contamination; and (3) provide information the would aid the design and construction of a domestic water supply system for impacted residents in the town of Nemo, South Dakota. This Executive Report provides a summary of the three volume Contaminant Survey and Site Characterization Report. Tables and figures that summarize pertinent information referenced to in this report are attached.

BACKGROUND

In the mid 1970s Forest Service personnel reportedly mixed and applied pesticides to trees in the Black Hills National Forest to fend off a bark beetle infestation in the area. Reported information indicated that containers and left over pesticides (EDB and Lindane mixed with diesel fuel and water) were disposed of behind the USDA–FS Nemo Work Center. Initial sampling of drinking water supply wells in the Nemo area was conducted by USDA–FS personnel. Initial analytical results indicated the pesticide EDB was detected in nine domestic supply wells in the area. Sixteen additional water supply wells were identified in the vicinity of Nemo (within two miles of town) and sampled by

USDA–FS personnel. Analytical results indicate EDB was not detected in any of the additional 16 wells.

In addition to EDB, other volatile organic compounds were detected in the Langley, Post Office, and Spleiss wells but were below maximum contaminant levels (MCLs) for safe drinking water. The source of these compounds is unknown; however, possible sources include a byproduct of chemical disinfection of drinking water in the Spliess well or degradation of other chemicals. The solvent trichloroethene (TCE) was also detected in the Post Office well at low concentrations below MCLs. TCE is commonly used as a parts cleaner/degreaser. Due to the low concentrations of these organic compounds, initial groundwater sampling and analysis efforts by the USDA–FS focused on EDB; however, these compounds continued to be monitored.

SOURCE INVESTIGATION

EnviroSearch conducted excavation activities in October 1996, to locate and remove the containers reported to have been buried behind the work center. Twelve areas were excavated. Buried debris was encountered at several locations, however, no pesticide containers or contaminated soils were identified. Excavation efforts were subsequently halted to assist the Forest Service with the installation of an alternative community water distribution system. Further efforts to identify potential pesticide container burial locations employed geophysical methods to measure subsurface electrical conductivity within selected locations. However, upon excavating those locations no containers of pesticides or evidence of residual soil contamination were observed.

MONITORING WELL INSTALLATION AND SAMPLING

During March 1997, EnviroSearch International supervised the drilling and construction of eight monitoring wells in the Nemo area. After reviewing the analytical results and the initial drilling data, an additional five monitoring wells were installed in May 1997. The five additional wells were sampled and analyzed to better delineate the contaminant plume. Some of these wells were also evaluated as potential domestic water supply wells for affected residents. The location of each monitoring well is identified on Figure 1. In addition to monitoring wells, spring seeps identified adjacent to the Flak property, near MW–12 and a tree stump located southwest of Troxell (northwest of MW–1) on the south side of the road were also sampled. The results of monitoring well sample analyses are summarized in Table 1.

Analytical results indicate the presence of EDB in groundwater samples collected from six of the thirteen monitoring wells and in the seep sample collected from the Flak property. The highest concentration (18.5 ug/l) was detected in the sample collected from MW–10. This concentration is at least 10 times higher than concentrations detected in any other monitoring well. EDB concentrations ranging from 0.13 ug/l to 1.0 ug/l were detected in groundwater samples collected from MW–1, MW–3, MW–4, and MW–12. These wells are all located adjacent to what has been interpreted as a northwest–southeast trending fault located to the southwest of the banded iron formation which forms a prominent ridge in the project area. The fault appears to extend from at least Boxelder Creek north of MW–1, to the open valley near MW–12. To the southeast (see Figure 2) Lower concentrations of EDB were detected in samples collected from the Flak seep (0.069 ug/l) and MW–11 (0.057 ug/l). EDB was not detected in samples collected from MW–2, MW–5, MW–6, MW–7, MW–8, MW–9 or MW–13. These observations indicate that: (1) there is a likely source area upgradient (northwest) of MW–10; (2) EDB concentrations in groundwater decrease to the east and west of the fault; and (3) the fault appears to control EDB migration in the project area.

Toluene concentrations ranging from 0.7 ug/l to 5.1 ug/l were detected in groundwater samples collected from four wells. Two of these wells (MW–8 and MW–9) are located to the southwest of the inferred fault line and are not impacted by EDB. Toluene is a common degreaser and a relatively volatile compound that could have been inadvertently introduced into the samples during drilling and/or introduced due to the presence of petroleum fuels in field vehicles and generators. Toluene is not considered a chemical of concern because of the low concentrations and sporadic presence.

DOMESTIC SUPPLY WELL SAMPLING AND ANALYSIS

Domestic water supply well sampling was initiated by the USDA–FS in October, 1996. Subsequent sampling activities conducted by EnviroSearch included the sampling of six domestic supply wells in March 1997 (Langely, Kaberna, Flak, 4T Old well, an unnamed well south of the Hooper well and the Pete Lien & Sons Mine) and nine domestic supply wells in May 1997 (Adams, Deverman #1, Deverman #2, Flak, Kaberna, Nemo Church, Post Office/Fire Department, Troxell/Keogh, and Weston). The May 1997 sampling reflected peak flow conditions and was conducted to evaluate seasonal trends in concentrations. The analytical results for domestic supply well samples collected by the USDA–FS and EnviroSearch are summarized on Table 2.

The results of domestic supply well analyses are discussed in order of decreasing magnitude. The highest EDB concentrations were detected in groundwater samples from the Kaberna well (9.4 ug/l to 12 ug/l) and the Troxel/Keough well (3.5 ug/l to 5.4 ug/l). These concentrations are consistent with those previously detected by the USDA–FS in October 1996. Groundwater samples collected by EnviroSearch from the Adams, Weston and Nemo Church wells contained EDB concentrations of 0.73 ug/l, 0.28 ug/l and 0.29 ug/l, respectively. A groundwater sample collected from the Post Office/Fire Department well contained 0.023 ug/l EDB. Groundwater samples collected from the Deverman and Flak wells were below laboratory detection limits with respect to EDB. The EDB concentrations in groundwater samples collected from Weston, Church and Krahn are an order of magnitude less than those previously detected by the USDA–FS likely due to dilution and flushing caused by increased precipitation. The Kaberna and Weston wells, and possibly the

Troxell/Keough wells, are hydraulically connected to the linear fault southwest of the ridge. However, Troxell/Keough is farther from the fault than MW–1 and exhibits EDB impact that is an order of magnitude higher. The presence of EDB in samples from the Adams, Church and Post Office wells and previous samples collected by USDA–FS personnel from the Spleiss, Krahn, and School wells suggests the presence of a separate source area to the east of the northwest–southeast fault line. The Troxell/Keough well is likely hydraulically connected to this separate source.

DISTRIBUTION OF EDB IN GROUNDWATER

Based on the observations presented thus far, it is likely that two EDB plumes are present within the project area (Figure 2). One plume is related to and controlled by the northwest–southeast trending fault previously discussed. Impacted wells associated with this plume include Weston, Kaberna, MW–4, MW–10, MW–3 and possibly MW–1 and Troxell/Keough. The second plume is likely controlled by local topography, bedrock structure, an east–west trending fault to the north of Troxell and structural contact that may cross Nemo Road in between MW–11 and the Fire Department.

The property owned by Homestake Mining does not appear to be impacted, based on the absence of EDB in wells MW–5, MW–8 and MW–13. The valley to the east and south of Nemo does not appear to be impacted by migration of EDB from the community of Nemo, based on the absence of this chemical in wells MW–6 and MW–7.

Groundwater appears to be in direct communication with Boxelder Creek where the northwest–southeast trending fault intersects the Creek, to the south of Kaberna. Contaminated groundwater has been identified flowing from a seep (Flak Seep) near MW–12 in this area.

EDB concentrations in groundwater appear to be relatively stable for samples collected from water supply wells between October 1996 and July 1997, with the exception of samples collected from three wells (Church, Krahn and Weston). Analytical results for groundwater samples collected from the Church and Weston wells in May 1997 and the Krahn well in July 1997 show an order of magnitude decrease in EDB concentrations. The decrease of EDB concentrations in these wells is likely due to increased precipitation and flushing of shallow groundwater resulting in EDB dilution at these locations.

Continued detection of EDB in impacted supply wells is anticipated due to the low analytical method detection limits, the inability to locate and abate the source(s), and the probability of continued contaminant presence in groundwater.

AQUIFER TESTING AND WATER LEVEL ANALYSIS

Aquifer tests and water level analysis were conducted to evaluate local groundwater flow patterns, fracture connectivity, and preferred contaminant migration. These activities also provided data to evaluate the degree of isolation of potential water supply development areas from those areas known to be impacted by EDB. Additional short–term aquifer tests were performed to evaluate the pumping capacity of specific wells.

Water levels in groundwater monitoring wells were gauged in March, May and June 1997 to determine baseline water level conditions and evaluate local groundwater gradients. The resulting piezometric surface contour and groundwater flow direction map for water levels collected on May 29, 1997 is presented as Figure 3.

Some of the pertinent conclusions resulting from the aquifer tests include:

- Some wells in the shallow bedrock aquifer responds rapidly to aerial recharge while others do not. This phenomenon could possibly be used to further distinguish wells into separate systems.
- The primary water bearing zones in the vicinity of Nemo are located within structural and lithological geologic features.

- The Spleiss well, Church well and possible the Adams well, are completed in a similar hydrogeologic regime.
- The Deverman wells appear to be hydraulically isolated from the EDB impacted groundwater within the community of Nemo.
- MW–13 is not currently impacted and does not appear to affect water levels in wells within the EDB plume when pumped. However, continued pumping of MW–13 may result in the appearance of EDB in this well due to: 1) the close proximity to the EDB plume; 2) groundwater recharge to this well from the highly permeable fault zone; and 3) the quantity of water that is produced.
- The rate of groundwater movement is estimated as 0.5 to 1.0 feet/day.

CONCEPTUAL HYDROGEOLOGIC MODEL

The primary mechanisms which control groundwater movement in the Nemo area include preferential flow paths created by structural and lithological geologic features, groundwater recharge from precipitation on higher slopes surrounding the site and from Boxelder Creek, and groundwater discharge at lower elevations where structural features converge and intersect Boxelder Creek.

The primary water bearing zones and groundwater transmission zones in the vicinity of Nemo are located within structurally and lithologically controlled geologic features including: 1) a northwest–southeast trending fault west and south of Nemo, 2) a northwest–southeast trending lithologic contact in Nemo and east of the bedrock ridge; and 3) east–west trending normal faults south of the town site.

Recharge to the shallow bedrock aquifer west of the iron rich bedrock ridge is provided by precipitation on the higher slopes west of Nemo. Groundwater west of the iron rich bedrock ridge generally flows from the northwest to the southeast following the strike–slip fault and southeast from MW–3 towards the Kaberna and Weston residences where geologic structures converge and groundwater discharges to Boxelder Creek at their intersection. Groundwater contaminated with EDB was observed flowing to the surface (Flak seep) at this location, therefore Boxelder Creek is in direct communication with the shallow bedrock aquifer.

The bedrock aquifer north and east of the bedrock ridge and beneath Nemo, exhibits sufficient permeability to promote infiltration of surface water from Boxelder Creek and transmission of groundwater to the southeast towards the Church well. The groundwater east of the bedrock ridge is interpreted to exhibit limited communication with the groundwater west of the ridge due to the presence of the fault and steeply dipping lower permeability strata which hydraulically separate the two flow regimes.

Within the town of Nemo, adjacent to the Troxell residence, Boxelder Creek is interpreted to exhibit a losing section where surface water discharges into the shallow bedrock aquifer and is transmitted southeast through preferential flow paths created by northwest–southeast trending fault and steeply dipping lithologic contacts. Water levels in wells located in the northern portion of Nemo (Troxell, Adams, Spleiss) appear lower than the elevation of Boxelder Creek throughout this reach and generally follow areas of high conductivity. The direction of groundwater flow from the Church would be influenced by northwest–southeast oriented lithologic contacts directing flow to the southeast and by drainage to Boxelder Creek to the east. Significant flow to the east would be limited by low permeability lithologic units present between Nemo Road and Boxelder Creek.

Boxelder Creek is interpreted to be a gaining stream as it enters the valley west of Nemo where recharge is largely controlled by local topography and the creek drains the topographically confined valley. East of Nemo, Boxelder Creek again becomes a gaining stream in the open valley towards the Kaberna residence. Groundwater conditions and the predominant gradient in the valley would be controlled by recharge from areas of elevated topography to the east and groundwater discharge into Boxelder Creek.

Based on the water quality data from groundwater monitoring wells, two independent sources of EDB appear to create two separate plumes which follow preferential flow paths created by regional geologic features. One source area is suspected to be located on the bedrock ridge between MW–3 and MW–10 with groundwater and contaminant migration controlled by the northwest–southeast trending fault and recharge from the higher slopes to the west. A second source area is likely located west of Troxell and MW–1 with groundwater movement controlled by discharge from Boxelder Creek to the northwest–southeast trending lithologic contact creating preferential flow paths towards the southeast. The EDB plume in the area east of the bedrock ridge would continue to migrate southeast in the direction of primary permeability. Migration of EDB east of the Church to Boxelder Creek could occur but is expected to be limited by steeply dipping lower permeability units in this area.

CONCLUSIONS

Key issues that affect the shallow bedrock aquifer system and the distribution of EDB in groundwater are discussed as follows:

- The open valley east and southeast of Nemo does not currently appear to be impacted by migration of EDB from the community of Nemo; the orientation of permeable geologic structures and primary gradient in the open valley is towards the east–southeast with some groundwater discharge occurring into Boxelder Creek throughout this reach; water supply wells directly east of Nemo do not appear impacted by migration of EDB; however, continued migration of EDB south and southeast of the Nemo Church is expected.
- The EDB contamination observed in the Kaberna and Weston residences is primarily due to contaminant migration in the strike–slip fault west of their properties; groundwater is in direct communication with Boxelder Creek where the northwest–southeast trending fault intersects the creek south of Kaberna; the distribution of EDB in the shallow bedrock aquifer south of Boxelder Creek and downgradient from MW–12 is unknown and this area does appear to be a groundwater discharge zone.

- Based on the water level and water quality data observed to date, the Deverman wells supplying the Nemo Guest Ranch appears to be upgradient and hydraulically isolated from the EDB impacted groundwater within the community of Nemo.
- The property owned by the iron mine is hydraulically cross gradient from the EDB plume and therefore is not impacted by EDB in groundwater as defined by the absence of EDB in wells MW–5, MW–8 and MW–13.
- Limited groundwater development potential for a moderate capacity alternative water supply well exists outside of the regional structural and lithologic features discussed above; most wells completed outside structural geologic features produce less than 5 gallons per minute (gpm) whereas wells completed near structural contacts produce up to 20 gpm. Well MW–3, adjacent to the northwest–southeast trending fault, has proven to be the best producer at 20 gpm.
- The rate of groundwater movement is estimated as 0.5 to 1.0 feet/day.

ALTERNATE WATER SUPPLY

Detailed discussions concerning the feasibility of various water supply options were presented in the Alternative Water Supply analysis (EnviroSearch, 1997a) provided to the Forest Service January 23, 1997. Results of the water supply alternatives analysis indicate development of a suitable alternative groundwater supply for the impacted residents of Nemo is feasible. The analysis also indicates several alternatives are more promising than others from a cost, reliability and public/regulatory acceptance point of view. Following completion of the subsurface investigation, the options for alternative water supply were reevaluated considering the revised hydrogeologic model, the contaminant distribution, and available groundwater yield data from the groundwater monitoring and pilot water supply wells.

Viable options for replacement of Nemo's drinking water revolve around installation of replacement wells near private users. Specific options for alternative replacement wells for the residents of Nemo include developing and treating groundwater from one or more monitoring wells including MW–3, MW–7, or MW–8, developing the Hooper well or an alternate water supply well north of Boxelder Creek and west of Nemo or treatment of an existing impacted water supply well. Specific options for alternative wells for the Weston residence include developing and likely treating MW–13, developing MW–8 or treatment of the original Weston well or other nearby impacted water supply well. Specific options for alternative wells for the Kaberna residence include developing MW–8, developing MW–7, installation of a new water supply well in the Kaberna valley, or treatment of the Kaberna well or other nearby impacted water supply well.

The criteria for selecting interim and final water supply options includes the following:

- Presence and availability of developable groundwater.
- Water usage needs/demands.
- Need to treat groundwater for EDB and possibly coliform.
- Reliability of a single alternative to provide a long term source of clean drinking water.
- Location of the developable groundwater; private vs. public land.
- Cost to transport the water to the distribution location.
- Requirements of the individual impacted residents.
- Risk and liability of any single alternative.

Key factors limiting the ability to provide local replacement wells for each residence includes: the presence of EDB beneath the town site, availability of developable groundwater in the immediate vicinity, costs associated with constructing conveyance systems over large distances or across Boxelder Creek, and the need to treat contaminated groundwater developed close to the existing EDB plume. Installation of replacement wells within property boundaries for residents within Nemo is not viable due to the distribution of EDB beneath the town. Installation of replacement wells on individual properties within Nemo is not cost effective or technically feasible without anticipating treatment of each individual well. Treatment of numerous wells is not cost effective or operationally desirable.

Sufficient developable groundwater supplies are not present in the Nemo area to provide individual replacement wells for each impacted resident within Nemo. In addition, construction of multiple conveyance systems to each individual impacted residence from replacement wells located in more remote areas is not cost effective. For these reasons, multiple users are anticipated to be required to share replacement wells at areas that can be developed safely and cost effectively. Sufficient groundwater (greater than 3 gpm) available for development is present southwest of Nemo near MW–3, MW–9, south of Nemo near MW–8, East of Nemo near MW–7 and across Boxelder Creek near the Hooper well which is interpreted to be completed in the east–west trending fault north of the creek. Development of MW–3 as a water supply well will require treatment to remove EDB and chlorination to remove bacteria. Development of a well near Hooper would require access to private property, piping of drinking water over considerable distances (3000–4000 ft), and crossing Boxelder Creek. Treatment of one or several water supply wells may be more cost effective than conveying groundwater over considerable distances. Development of shallow groundwater or surface water from Boxelder Creek is likely not cost effective and undesirable due to excess operation, maintenance, and treatment costs.

Installation of replacement wells for the Kaberna and Weston residence is also considered a viable alternative. Similarly, placing a well as close as possible to affected users is desirable, however developing water at distances from the EDB plume will minimize future risk of contaminating drinking water supplies. Installation of a community water supply well or wells as close to affected users as practical to minimize conveyance costs yet far enough away from the EDB plume to minimize future risk of contaminating drinking water supplies is preferred. Developing MW–13 as a replacement water supply well without treatment is not believed to be a reliable alternative due to the close proximity of MW–13 to the EDB plume and high permeability associated with the fault zone. Less risk of impacting future water supplies would occur with increasing lateral distance from the fault zone.

Conceptually, the lowest cost alternatives are for providing an alternative groundwater source from an area hydraulically isolated from the zone of contamination or treating an existing well capable of providing ample drinking water. The initial capital costs of treating a single water supply well are comparable to constructing a pipeline to convey water approximately 1000 to 1500 feet from a source outside the impacted area. Reliability of the various alternatives needs to be carefully considered. A water supply well (or wells) confidently located in an area hydraulically isolated from contamination or treatment of groundwater from a non–isolated source is the most reliable water supply option. Removal of EDB from groundwater via carbon adsorption is also considered reliable although the number of treatment units considered affects the financial viability of this alternative.

RECOMMENDATIONS

Given that limited options are available for developing an alternative drinking water system and there is a recognized desire to terminate continued trucking of potable water as soon as possible, EnviroSearch recommends implementation of an interim water supply system while identifying long term options for impacted residences. The interim measures would develop the identified water supplies with the highest probability of successfully supplying the residents with drinking water.

Based on the information available to date, EnviroSearch recommends developing MW–8 as an interim water supply the Weston residence while exploring the presence of developable groundwater in the Kaberna valley with an additional pilot well. In addition, development of MW–3, MW–7, or MW–8 as an interim water supply well for the community of Nemo should be considered and compared to developing groundwater supplies north of Boxelder Creek. The community and USDA–FS reactions to or positions regarding a treated water supply should be considered. In addition, the cost of treatment vs. piping of water and associated risk management aspects of specific alternatives should be evaluated. EnviroSearch also recommends that the USDA–FS:

- Propose a design for an interim water supply system to the residents of Nemo as a basis for further discussion of the existing limitations, conditions, and decision factors. A public meeting is proposed to convey the results of the site characterization program to the residents of Nemo with an interim water supply proposal to initiate the public participation process.
- Determine the fate of EDB impacted groundwater below, adjacent to (Flak property), and downgradient of Boxelder Creek.
- Determine the alternative water supply options and requirements.
- Determine the final water supply requirements for the impacted residents.
- Develop a standard policy, in conjunction with the State of South Dakota and EPA, on usage of EDB impacted water supply wells by residents of Nemo.
- Develop an approach to continued monitoring of groundwater wells, water supply wells, and if necessary, surface water.
- Consider a limited soil gas survey along the roads near the suspected sources of groundwater contamination and conduct limited soil sampling at selected locations (i.e. suspected former mixing/staging locations).
- Identify long term remedial requirements, options and limitations for impacted groundwater.

Table 1
Summary of Laboratory Analysis for Nemo Monitoring Well and Seep Samples
(ug/l*)

Sampling Location	Date of Laboratory Submittal	EDB	Benzene	Ethyl–benzene	Naphtha–lene	Toluene	Total Xylenes	Isopropyl–benzene (Cumene)
MW–1	3/27/97	**0.13**	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50
MW–2	3/31/97	<0.020	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50
	3/25/97	**0.025**	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50
MW–3	5/14/97	<0.020	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50
	6/20/97	**0.16**	<0.50	<0.50	<0.50	**1.10**	<1.00	<0.50
	7/1/97	**0.091**	<0.50	<0.50	<0.50	<0.50	<1.00	**0.69**
MW–4	3/17/97	**1.0**	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50
MW–5	3/15/97	**0.021**	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50
	3/28/97	<0.020	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50
MW–6	3/31/97	<0.020	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50
MW–7	3/31/97	<0.020	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50
MW–8	3/14/97	<0.020	<0.50	<0.50	<0.50	**0.74**	<0.50	<0.50
MW–9	5/12/97	<0.020	<0.50	<0.50	<0.50	**5.10**	<1.00	<0.50
MW–10	5/12/97	**18.5**	<0.50	<0.50	<0.50	tr	<1.00	<0.50
MW–11	5/14/97	**0.057**	<0.50	<0.50	<0.50	**1.20**	<1.00	<0.50
MW–12	5/14/97	**0.55**	<0.50	<0.50	<0.50	tr	<1.00	<0.50
MW–13	6/20/97	<0.020	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50
MW–13 post pump	6/25/97	<0.020	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50
Seep Flak	5/12/97	**0.069**	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50
Stump Seep	5/14/97	<0.020	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50
MCL		0.05	5	700	NA	1000	10000	NA
RBC		0.00075	0.36	1300	1500	750.00	1400	1500

NOTES:
NA – Not Analyzed or Not applicable
tr – trace; detected below the quantification limit
RBC – Risk Based Concentrations from EPA Region III Table.
Concentrations assume residential exposure by tap water ingestion.
*1 ug/l is approximately equal to 1 ppb
MCL – Federal Drinking Water Maximum Contaminant Level

EnviroSearch International
September 3, 1997
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Table 2
Summary of Laboratory Analyses
For Nemo Well Water Samples (ug/l*)

Sampling Location	Date of Laboratory Submittal	EDB	Benzene	Toluene	Ethyl-benzene	Total Xylenes	Naphtha-lene	1,2,3-Trichloro-benzene	Isopropyl-benzene (Cumene)	Trichloro-ethene	Bromo-dichloro-methane	Bromo-form	Chloro-form	Dibromo-chloro-methane
Adams Elton	10/08/96	**0.92–0.93**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	10/16/96	**0.86**	<0.20	<0.20	<0.20	<0.20	<0.50	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	05/27/97	**0.73**	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Atkinson	10/22/96	<0.010	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Church	10/08/96	**1.3–1.8**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	10/16/96	**1.4**	<0.20	<0.20	<0.20	<0.40	<0.50	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	05/27/97	**0.29**	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Cooper Derrall	10/08/96	<0.010	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Deverman #1	10/08/96	<0.010	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	05/27/97	<0.020	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Deverman #2	10/08/96	<0.010	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	05/27/97	<0.020	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Eggers	07/01/97	<0.020	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Fieron	10/22/96	<0.010	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fieron 2nd House	10/22/96	<0.010	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Flak	03/28/97	<0.020	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	05/19/97	**0.018**	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Flak Seep	05/19/97	**0.069**	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Ford	10/16/96	<0.010	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ford Shirley	10/22/96	<0.010	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hageman KC	10/08/96	<0.010	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kaberna	10/22/96	**13**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	10/29/96	**10**	<0.20	<0.20	<0.20	<0.20	<0.50	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	03/25/97	**9.4**	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	05/19/97	**12**	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Krahn	10/08/96	**0.17**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	10/16/96	**0.13**	<0.20	<0.20	<0.20	<0.40	<0.50	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	07/01/97	**0.045**	<0.50	<0.50	<0.50	<1.00	<0.50	**0.52**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Langley	10/16/96	<0.010	<0.20	<0.20	<0.20	<0.40	<0.50	<0.50	<0.20	<0.20	<0.20	<0.20	**0.69**	<0.20
	03/31/97	<0.020	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Martin	10/22/96	<0.010	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Federal Drinking Water MCL		0.05	5	1,000	700	10,000	NA	NA	NA	5.0	NA	NA	NA	NA
RBC		0.00075	0.36	750	1300	1400	1500	NA	1500	1.6	0.17	2.4	0.15	NA

NOTES:

NA – Not Analyzed or Not Applicable
TS – INF/Spleiss – Treatment System Influent
MCL – Maximum Contaminant Level

tr – trace; detected below the quantification limit
TS – EFF/Spleiss – Treatment System Effluent
RBC – Risk Based Concentrations from EPA Region III Table. Concentrations assume residential exposure by tap water ingestion.

*1 ug/l is approximately equal to 1 ppb

Table 2
(continued)
(ug/l*)

Sampling Location	Date of Laboratory Submittal	EDB	Benzene	Toluene	Ethyl-benzene	Total Xylenes	Naphtha-lene	1,2,3-Trichloro-benzene	Isopropyl-benzene (Cumene)	Trichloro-ethene	Bromo-dichloro-methane	Bromo-form	Chloro-form	Dibromo-chloro-methane
Post Office/Fire Dept	10/08/96	**0.062**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	10/16/96	**0.045**	<0.20	<0.20	<0.20	<0.40	<0.50	<0.50	<0.20	**0.27**	<0.20	<0.20	<0.20	<0.20
	10/29/96	**0.053**	<0.20	<0.20	<0.20	<0.20	<0.50	<0.50	<0.20	**0.22**	<0.20	<0.20	<0.20	<0.20
	05/27/97	**0.023**	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
School	10/08/96	**1.12**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	10/16/96	**0.82**	<0.20	<0.20	<0.20	<0.40	<0.50	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	06/25/97	**1.1**	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Smith	07/01/97	<0.020	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Spleiss House	10/08/96	**0.47**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	10/16/97	**1.0**	<0.20	<0.20	<0.20	<0.40	<0.50	<0.50	<0.20	<0.20	**0.28**	**2.8**	**0.85**	**0.96**
	10/22/96	**1.0**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TS–INF/Spleiss	05/22/97	**3.6**	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	**1.20**	<0.50	<0.50	<0.50	<0.50	<0.50
TS–EFF/Spleiss	05/22/97	<0.020	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Troxell / Keough	10/08/96	**4.7–5.4**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	10/16/96	**3.5**	<0.20	<0.20	<0.20	<0.40	<0.50	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	05/27/97	**5.4**	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Troxell Lilian	10/22/96	<0.010	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Troxell Buck	10/29/96	<0.010	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tungland	10/22/96	<0.010	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Weston	10/22/96	**2.2**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	10/29/96	**1.7**	<0.20	<0.20	<0.20	<0.20	<0.50	<0.50	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20
	05/19/97	**0.28**	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Witcap	10/22/96	<0.010	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zopp Donna	10/22/96	<0.010	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Creek E & W of Nemo	10/08/96	<0.010	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4 T Old	03/19/97	**0.053**	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Mine	03/19/97	<0.020	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Unknown well south of Hooper	03/19/97	<0.02	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Federal Drinking Water MCL		0.05	5	1,000	700	10,000	NA	NA	NA	5.0	NA	NA	NA	NA
RBC		0.00075	0.36	750	1300	1400	1500	NA	1500	1.6	0.17	2.4	0.15	NA

NOTES:

NA – Not Analyzed or Not Applicable

TS – INF/Spleiss – Treatment System Influent

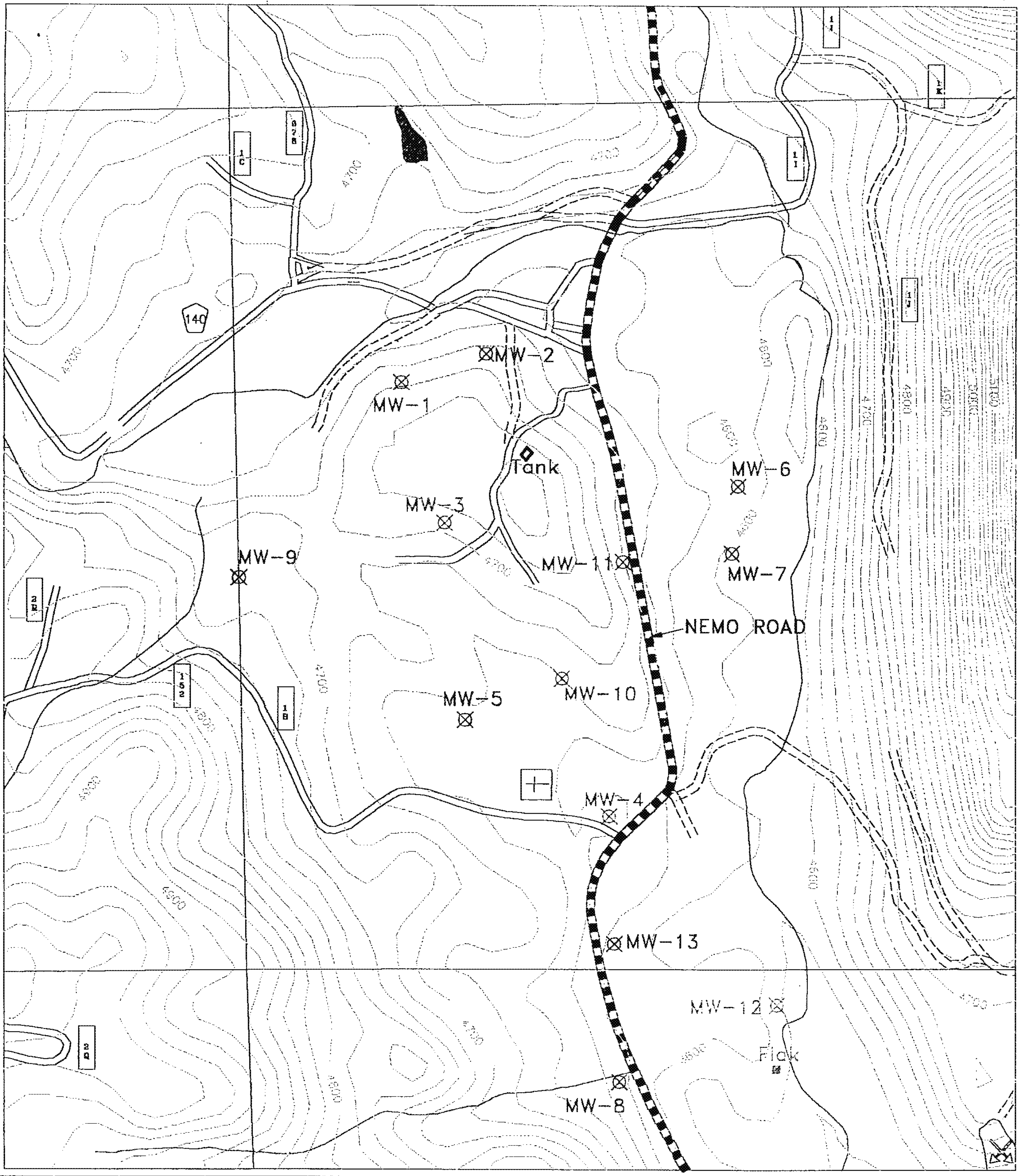
MCL – Maximum Contaminant Level

tr – trace; detected below the quantification limit

TS – EFF/Spleiss – Treatment System Effluent

RBC – Risk Based Concentrations from EPA Region III Table. Concentrations assume residential exposure by tap water ingestion.

*1 ug/l is approximately equal to 1 ppb



LEGEND

MW-10 MONITORING WELL (IMPACTED IN RED, NON-IMPACTED IN BLUE)

0 800 FEET

APPROXIMATE SCALE

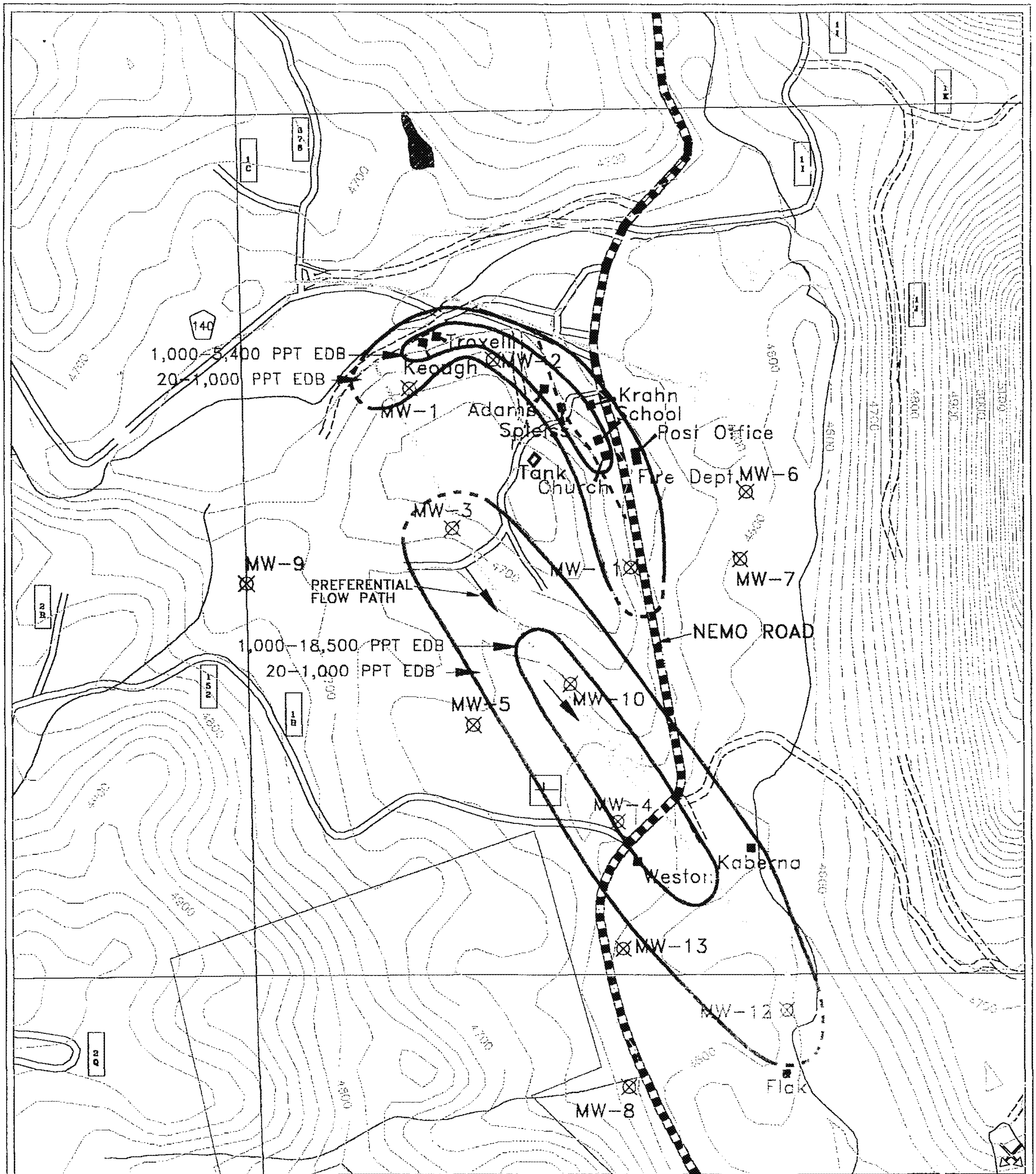
EnviroSearch INTERNATIONAL

FIGURE 1

MONITORING WELL LOCATION MAP

NEMO, SOUTH DAKOTA

8/12/97	P# 1752	(11VQ12A)



LEGEND

MW–1	MONITORING WELL (IMPACTED IN RED, NON–IMPACTED IN BLUE)
School	IMPACTED DOMESTIC WELL
	EDB CONTAMINANT PLUME (DASHED WERE APPROXIMATED)
	FAULT
	LITHOLOGIC CONTACT

N

0 800 FEET

APPROXIMATE SCALE

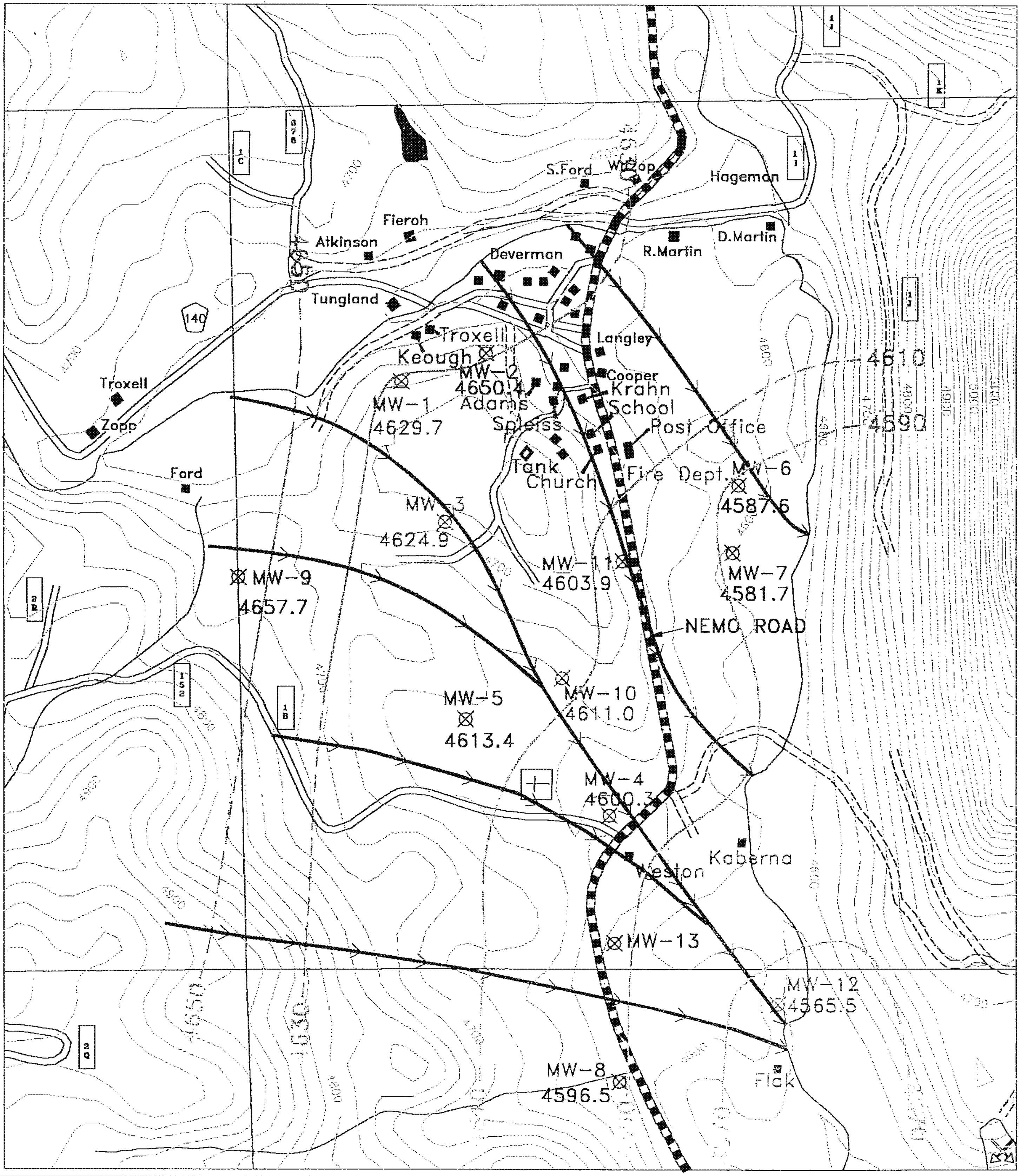
EnviroSearch INTERNATIONAL

FIGURE 2

DISTRIBUTION OF EDB IN GROUNDWATER

NEMO, SOUTH DAKOTA

8/12/97	P# 1752	(11VR12A)



LEGEND

MW-10 MONITORING WELL (IMPACTED IN RED, NON-IMPACTED IN BLUE)

4610 GROUNDWATER ELEVATION IN FEET

School IMPACTED DOMESTIC WELL (IMPACTED IN RED, NON-IMPACTED IN BLACK)

EQUIPOTENTIAL LINE IN FEET (DASHED WHERE INFERRED)

FLOW LINE

N

0 800 FEET

APPROXIMATE SCALE

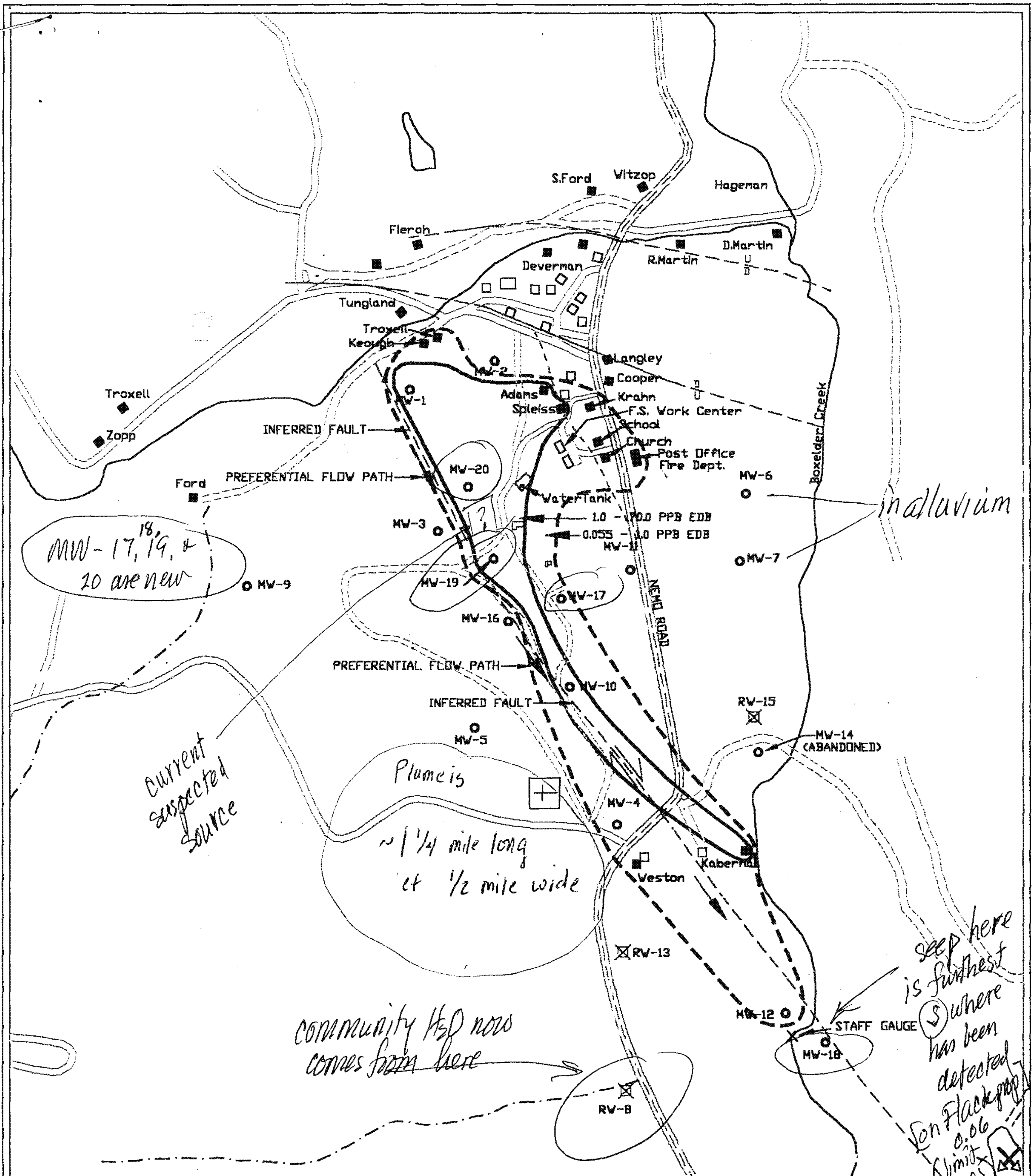
EnviroSearch INTERNATIONAL

FIGURE 3

PIEZOMETRIC SURFACE CONTOUR AND GROUNDWATER FLOW DIRECTION MAP

NEMO, SOUTH DAKOTA

8/12/97	P# 1752	(11VQC12)



LEGEND

○ MW-6	MONITORING WELL (IMPACTED IN RED NON-IMPACTED IN BLUE)
■ School	DOMESTIC WELL (IMPACTED IN RED) NON-IMPACTED IN BLACK)
	EDB CONTAMINANT PLUME

0 800 FEET

APPROXIMATE SCALE

EnviroSearch INTERNATIONAL

DISTRIBUTION OF EDB IN GROUNDWATER

NEMO, SOUTH DAKOTA
JANUARY 29, 1999

2/25/99	P# 1752 E	(12JQ)